



The Epidemiological Characteristics of Motorcyclists Associated Injuries in Road Traffic Accidents; A Hospital-Based Study

Saber Ghaffari-fam¹, Ehsan Sarbazi², Amin Daemi³, Mohammad Reza Sarbazi⁴, Hossein Ali Nikbakht⁵, Shaker Salarilak^{6*}

¹School of Nursing of Miandoab, Urmia University of Medical Sciences, Urmia, Iran

²Department of Statistics & Epidemiology and Student Research Committee, School of Health, Tabriz University of Medical Sciences, Tabriz, Iran

³Health management and economics research center, Iran university of medical sciences, Tehran, Iran

⁴PhD student in applied ELT at Ilam University, Faculty of humanities and foreign languages Ilam, Iran

⁵Social Determinants of Health Research Center, Faculty of Medicine, Babol University of Medical Sciences, Babol, Iran

⁶Department of Public Health, Medical Sciences Faculty, Islamic Azad University, Tabriz, Iran

*Corresponding author: Shaker Salarilak

Address: Department of Public Health, Medical Sciences Faculty, Islamic Azad University, Tabriz, Iran.

Tel: +98-914-4027218; Fax: +98-411-3340308

e-mail: salarilak@yahoo.com

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ABSTRACT

Objectives: To determine the epidemiology of injuries of the motorcyclists in road traffic accidents (RTIs) between 2008 and 2014 in East Azarbayegan province of Iran.

Methods: A cross-sectional study was performed in East Azerbaijan province in Imam Reza hospital on motorcyclists subjected to injuries in RTIs between 2008 and 2014. Demographic characteristics (age, sex), duration of hospitalization, final status of injured people after discharge from the hospital, admission ward, number of admissions due to injuries in RTIs, nature of injury, and the clinical services provided to injured people were gathered from hospital information system (HIS). Demographic characteristics (age, sex), duration of hospitalization, final status of injured people after discharge from the hospital, admission ward, number of admissions due to injuries in RTIs, injured site of the body, nature of injury, and the clinical services provided injured people were gathered from HIS. Standardized data collection form was used for uniform handling of the data.

Results: Most of the victims (94.4%) were male. The most frequent injuries pertained to the age group of 18-30 with 1676 (51.4%) injuries. Head, abdomen, lower back, lumbar spine, and pelvis, were the most common injured sites, respectively. Reduction of fracture and dislocation and cranial puncture were the most common provided services. The lowest survival time belonged to the age group over 60 years old.

Conclusion: Injuries to the head are the most prevalent injuries among motorcyclists in RTIs. So it is suggested that proper interventions be implemented to ensure wearing helmet by motorcyclist and pillion passengers.

Keywords: Epidemiology; Motorcycles; Injury; Morbidity; Iran.

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Introduction

All around the world, one of the prominent external causes of morbidity and mortality, regardless of income or geographic area, is injury [1,2]. About 12% of disease relates to injuries worldwide [3]. The mortality rate of RTIs in the Eastern Mediterranean region is 26.4 per 100,000, but in the European region the corresponding value is 17.4 per 100,000. However, worldwide this amounts to 19 per 100,000 [4]. Annually, about 400,000 people under 25 years of old die on roads across the world. Most of these deaths occur among vulnerable road users such as pedestrian, cyclists, motorcyclists and those using public transportation [5,6]. Iran is a country which has one of the greatest RTIs mortality rate. The road traffic death rate per 100,000 population in Iran is 32.1 and proportion of drivers/passengers of motorized 2-wheelers is 21.5% [7,8]. It is anticipated that by 2020, deaths resulting from RTIs will be the third and second leading cause of death in high income and middle/low income countries respectively [7]. RTIs lead to economic losses of about 1-1.5% of the annual Gross National Product (GNP) in low-and-middle income countries [1]. The economic burden of RTAs in Iran is 1.4% of Gross Domestic Product (GDP) [9].

Nowadays, motorcycles are considered to be a good solution for bypassing heavy traffic because they are economical and convenient vehicles [10]. Motorcycle might be appropriately alternative means of transport due to cheaper petrol prices [11].

Motorcyclists in comparison to four-wheel drivers are ten times more exposed to road traffic injury [12]. Besides, in the world motorcyclists are about three times more probable than car occupants to be injured in the RTIs, and sixteen times more probable to die due to RTIs [13]. It was reported that more than 50% of motorcycle crashes took place during day time, based on analysis of fatal two-vehicle crashes between passenger vehicle and motorcycle [14]. In Iran, fatality frequency indicated that 5000 people died and 70,000 were injured in motorcycle accidents [15]. Furthermore, since children, teenagers and active economic population are highly involved in motorcycle accidents, much attention is directed to this kind of accident due to high rate of life lost ratio and cost involved [16]. It has been shown that the Disability Adjusted Life Years (DALY) of road traffic injuries in Iran are more than 1.07 million, ranking it the highest among all other diseases [17]. It is expected that, if appropriate measures are not taken, road traffic crashes will cause almost 1.9 million people to die annually by 2020 [4]. In this study, our aim was to describe epidemiological patterns of motorcyclists' injuries in RTIs admitted to Imam Reza hospital of Tabriz city, Northwest of Iran, to propose appropriate care and timely aids to victims as well.

Materials and Methods

Study Population

A cross-sectional study was conducted in Imam Reza referral hospital of East Azerbaijan province, Iran. Data was extracted from Hospital Information System (HIS). Study subjects were all motorcyclists who have been injured in RTIs during 2008-2014. All eligible subjects included in the study (census). Inclusion criteria were: drivers and/or passengers of motorized 2-wheelers injured in RTIs, inpatient victims, unintentional injuries, injuries happened in East Azerbaijan province, time period 2008-2014. Exclusion criteria were: victims that their information was incomplete, outpatient victims, patients referred from other provinces. The study protocol was approved by the institutional review board (IRB) and the medical ethics committee of Tabriz University of Medical Sciences. As this was a retrospective study, no informed written consent was required.

Study Protocol

Standardized data collection form was used for data collection to ensure uniform handling of the data. The data extracted from the HIS then compared with the medical records to ensure the correctness and completeness of the data. In other words, further to the HIS data, medical records of all study subjects reviewed. In case of conflict between the HIS data and the medical record of the injured patient, the medical record taken as correct one. Data collection form included: age, gender, duration of hospitalization, number of admissions, admission ward, hospital discharge status, injured site of the body, and nature of injury. In order to describe injured site of the body and nature of the injury chapter XIX of International Classification of Disease (ICD-10) was followed [18]. External causes of morbidity and mortality of motorcyclists and pillion passengers injured in collision with any obstacle were reported based on chapter XX. The codes belong to the XIX chapter of the injury, poisoning and certain other consequences of external causes of ICD-10 codes including: “ (S00-S09) Injuries to the head; (S010-S19) Injuries to the neck; (S20-S29) Injuries to the thorax; (S30-S39) Injuries to abdomen, lower back, lumber spine, and pelvis; (S40-49) Injuries to the shoulder and upper arm; (S50-S59) Injuries to the elbow and forearm; (S60-S69) Injuries to the wrist and hand; (S70-S79) Injuries to the hip and thigh; (S80-S89) Injuries to the knee and lower leg; (S90-S99) Injuries to the ankle and foot; (T00-T07) Injuries involving multiple body region”, and data of the clinical services provided to the victims was collected according to International Classification of Diseases 9 Clinical Modification (ICD-9-CM) [19].

Statistical Analysis

Descriptive statistics including frequency (relative

frequency) was applied to describe the central and dispersion values such as mean \pm SD, median (Inter Quartile Range) according to data distribution. Age was categorized into six age groups in the following way: <7, 7-18, 18-30, 30-45, 45-60, over 60 years. Chi-square test was run to compare nominal variables and one-way ANOVA was applied to compare means the difference between more than two different levels. Furthermore, MANOVA was used to test the difference of the two continuous dependent variables between the groups. To determine survival time, Kaplan-Meier method and a comparison among categories of log rank test was used. All analyses performed by the STATA version 11 software. A 2-sided *p* value of less than 0.05 was considered statistically significant at all stages of analysis and interpretation.

Results

In total, people injured in RTIs during 2008-2014 were 3077. The Male/Female ratio for motorcyclists was 16.90. The average age of victims was 32.62 \pm 13.61, and their ages ranged from 6 months to 89 years old. Some demographic characteristics of injured motorcyclists, the most common injuries according to the sites of body of injured motorcyclists, and place of occurrence of injuries that were referred to Imam Reza hospital of victims with injuries in RTI

are represented in Table 1.

Table 2 shows the major types of injuries and the clinical modification provided for motorcyclist victims referred to Imam Reza hospital. The most frequent injuries were bone fractures and intracranial injuries. And the majority of clinical services given to patients were treatment of fracture and dislocation 15% and cranial puncture 15%. The median length of stay in the hospital was 5 days and Inter Quartile Range (IQR) was 7 days, and the average hospitalization was 8.45 \pm 12.22 days. The average length of hospitalization of patients with T00-T07 codes (Injuries involving multiple body region) was 5.54 \pm 8.10 days and S01-S09 (Injuries to the head) was 7.88 \pm 9.79 days. These two groups had the shortest length of stay. Average length of stay of patients with S60-S69 (Injuries to the wrist and hand) was 14.87 \pm 18.85 days and of the patients with S70-S79 codes was 13.09 \pm 18.99 days. These two groups had the longest length of stay in hospital (*p*=0.001). Based on discharge status, the average age of victims who died in RTIs [males 35.85 \pm 14.59 and females 46.61 \pm 15.67 years], improved individuals [males 31.63 \pm 12.82 and females 36.71 \pm 16.11 years] and subjects who recovered with certain complications [males 32.26 \pm 13.59 and females 35.42 \pm 15.88 years] was significantly different (*p*=0.001).

Figure 1 shows the Kaplan-Meier survival estimates for age categories. The lowest survival time among

Table 1. Demographic characteristics, the most common injured site of body, and place of accidents of motorcyclist victims referred to Imam Reza hospital, East Azerbaijan province, Iran 2008-2014.

Variables	Description	Frequency (Relative frequency)
Age groups	<7	19 (0.6%)
	7-18	171 (5.2%)
	18-30	1676 (51.4%)
	30-45	834 (25.6%)
	45-60	402 (12.3%)
	>60	158 (4.8%)
Gender	Male	3077 (94.4%)
	Female	182 (5.6%)
Admission ward	Trauma	1873 (57.5%)
	Operation	616 (18.9%)
	Ear, Nose & Throat	129 (4.0%)
	Face & Mandible	350 (10.7%)
Number of admissions	Other	292 (9.0%)
	One	2660 (81.6%)
	Two	407 (12.5%)
Injured site of the body	Three or more	193 (5.9%)
	Injuries to the head, and neck	3719 (62.7%)
	Injuries to abdomen, lower back, lumbar spine, and pelvis, and thorax	776 (13.1%)
	Injuries to the shoulder and upper arm, elbow and forearm, and wrist and hand	357 (6.0%)
	Injuries to the hip and thigh	305 (5.1%)
Place of occurrence	Injuries to the knee and lower leg, ankle and foot	770 (13.0%)
	Alleys	1172 (37.1%)
	Street and highway	1538 (47.2%)
	Trade and service area	353 (10.8%)
	Industrial and construction area	139 (4.3%)
	Other	22 (0.73%)

Table 2. The most frequent types of injury and the most clinical services provided to injured motorcyclists referred to Imam Reza hospital, East Azerbaijan province, Iran 2008-2014.

Type of Injury	Definition		Frequency (relative frequency)
	Fracture bones		2304 (38.9%)
	Intracranial injury		1828 (30.8%)
	Injury of intra-abdominal organs		248 (4.2%)
	Other and unspecified injuries		1042 (17.6%)
	Other less frequent injuries (totally)		516 (8.5%)
Clinical services provided	Operation Codes	Definition	Frequency (relative frequency)
	01	Cranial puncture	635 (15.0%)
	02	Other operation on skull, brain and cerebral meninges	211 (5.0%)
	34	Operations on chest wall, pleura, mediastinum and diaphragm	306 (7.2%)
	54	Other operations on abdominal region	371 (8.7%)
	76	Operation on facial bones and joints	363 (8.5%)
	79	Reduction of fracture and dislocation	637 (15.0%)
	86	Operations on skin and subcutaneous tissue	339 (8.0%)
	93	Physical therapy , respiratory therapy rehabilitation, and related procedures	305 (7.2%)
	96	No operative intubation and irrigation	242 (5.7%)
	--	Other less frequent services (totally)	836 (19.7%)

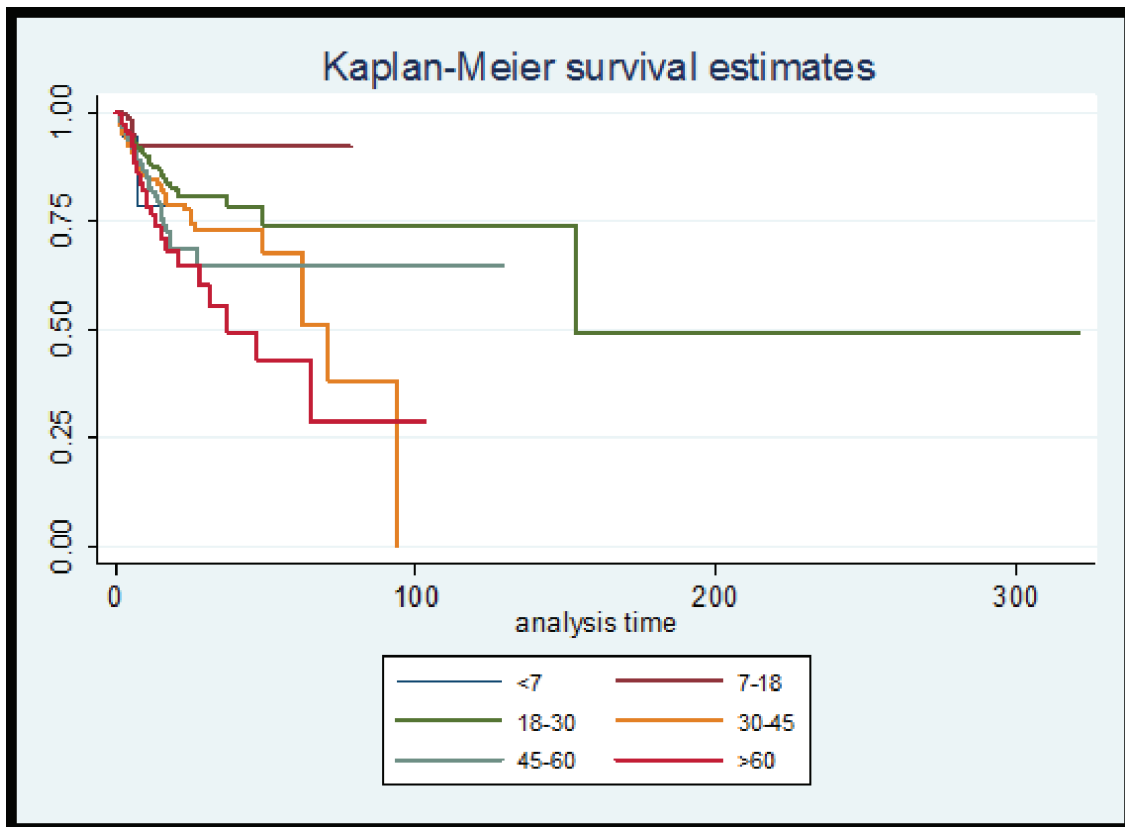


Fig. 1. Comparison of survival time among age categories of victims referred to Imam Reza hospital, East Azerbaijan province, Iran 2008-2014 [days].

age categories belonged to the age category over 60 years old. The highest survival time belonged to age category of 18-30 with 199.22±35.32) days. The lowest survival time according to injured site of the body pertained to the injuries to the elbow and forearm 32.82±3.75 days, injuries to the shoulder and upper arm (34.57±3.17 days), and the greatest survival time related to the hip and thigh injuries

(163.34±6.20) days.

Motorcyclists injured in collision with car, pick-up truck or van formed the majority of victims compared to other categories (Table 3). In addition, the difference between injured site of the body and external causes of injuries was statistically significant with the majority of head injuries occurred in collision with car, pick-up truck and van ($p=0.001$).

Table 3. Distribution of external causes of morbidity and mortality in accordance with twentieth chapter of ICD-10 pertained to motorcyclists referred to Imam Reza hospital, East Azerbaijan province, Iran 2008-2014.

Codes	Definition	Frequency (Relative frequency)
V20	Motorcycle rider injured in collision with pedestrian or animal	62 (1.9%)
V21	Motorcycle rider injured in collision with pedal cycle	4 (0.1%)
V22	Motorcycle rider injured in collision with two or three-wheeled motor vehicle	132 (4.0%)
V23	Motorcycle rider injured in collision with car, pick-up truck or van	1586 (48.6%)
V24	Motorcycle rider injured in collision with heavy transport vehicle or bus	202 (6.2%)
V26	Motorcycle rider injured in collision with other no motor vehicle	6 (0.2%)
V27	Motorcycle rider injured in collision with fixed or stationary object	148 (4.5%)
V28	Motorcycle rider injured in no collision transport accident	792 (24.3%)
V29	Motorcycle rider injured in other and unspecified transport accidents	325 (10.0%)

Discussion

Findings of this study revealed that the most injured site of the body in motorcyclists injured in RTIs was the head and the most provided services to them were cranial puncture and reduction of fracture or dislocation. The majority of the motorcyclist victims of the RTIs were male adults (age group 18-30). Yet the lowest survival rate belonged to the age group over 60 years old.

About half of those dying on the world's roads are "vulnerable road users": pedestrians, cyclists and motorcyclists [20-23]. Among road users, two wheeler vehicle collisions comprised the most proportion. This may be as a result of lack of ability in proper traffic management, especially, handling high speed [15,24]. Findings of the study showed a high male/female ratio in motorcyclists injured in RTIs (16.9:1). Other studies from different cities of Iran also reported a high male/female ratio in victims of motorcycle crashes [15:1 and 28:1] [20,25]. The higher exposure among males may have multiple reasons. It may be due to the type of occupations they encounter. Alternatively, the reason can be males' propensity to take risky behaviors more frequently than their female counterparts. Finally, it may result from the fact that females aren't motorcyclists in Iran like other middle-income countries [16,21,26-29]. Injuries to the age categories of 18-30 and 30-45, respectively, had highest frequency compared with other age categories. Another study by Nwadiaro (North-central Nigeria) reported the age group of 21-30 to have the highest percentage of motorcycle-related injuries in the RTIs [14,30]. Among all users of road, motorcyclists are the youngest [29,30]. These age groups who are economically independent become more susceptible to injury in RTIs [31,32].

While in the present study the average age of victims was 32.62±13.61, studies carried out in other parts of the globe differ in this regard for example, a study conducted in turkey by Emre Eroğlu found that the average age of victims was 28.47 years [10]. Similarly, in another study done in Fars province the average age of patients was 31.4±16.5 years [20]. In a similar study in China, the average age of victims

with fatal outcome of motorcycles was 35.5±12.0 [28]. The finding that injuries to the head were the most prevalent causes of hospitalization, is in line with other studies [13,14,27]. The literature also states the injury to brain as the prominent cause of death [33]. In many studies done across the world upper extremity injuries were the most prevalent among age group above 60 [19,26,34,35]. Injuries to the upper extremity may be correlated with increasing age [10], in other words the higher the age, the more the injuries to upper extremity in RTIs. Because most of motorcyclists do not wear a helmet [31,32] and illegally transport pillion passengers and cargo [36] using helmets can reduce the risk of head injury about 69% and the risk of death about 42% [36]. Furthermore, use of helmet, speed of vehicle, presence of emergency medical services (EMS), and accessibility to health care may play key positive role and in the final status of motorcyclist RTI victims [15]. Yet non-standard helmets can result in more severe head injuries compared with standard helmets [7,29]. In the present study skull fracture was the most common injury among motorcycle riders and pillion passengers, which agrees with the results achieved by other studies [37,38]. A cross-sectional study in Tehran, Iran showed that Tibia fracture with 49.8% formed the greatest proportion among RTI victims [38]. Hui *et al.* in a study in China country reported soft tissue injuries and facial fractures were the most common injuries among motorcycle riders and pillion passenger [28].

Based on our findings increasing age was associated with death. While the lowest survival observed in the age group over 60 years, the individuals in the age group of over 60 comprised the highest proportion of deaths. Another study done in Mashhad city, Iran showed that ages between 21-30 years had to be peak in motorcycle deaths [29]. The high mortality in young motorcycle riders might be due to risky behaviours such as speeding, not using a helmet during riding, and running yellow light [4,39,40]. The age group over 60 years, compared to other age groups, also had significantly lower survival in fall injuries in a study in the same province ($p=0.001$) [41].

The most clinical services provided to the patients

were reduction of fracture, dislocation and other operation on skull, brain and cerebral meninges. We have found that in Tabriz, reduction of fracture with internal fixation was the most prevalent type of clinical services provided for the RTIs victims. Identification of the epidemiological characteristics of the people who are injured in RTIs can help us to focus on high risk groups and then to reduce the morbidity and mortality of the RTIs. In this study injuries to the head were the most significant type of injuries related to motorcyclists in RTIs. These injuries also were the prominent causes of deaths both in motorcycle riders and pillion passengers. While, using standard helmets can reduce the head injuries and death to a considerable extent. Then a strong national regulation is required to make helmet mandatory for motorcyclists.

A limitation of this study is studying the motorcyclists involved in RTIs in only one hospital. Yet, the participated hospital is a tertiary care referral general hospital that admits more than 60% of all motor vehicle injuries of the city (compared

to other 20 hospitals that totally admit less than 40%) [33]. Another limitation of the study is that the information is limited more to individual injuries rather than environmental accident scene. In addition, due to retrospective study design and the chart review method for data collection, information bias may be of concern. In this regard, the main issues are imperfect registry of data or detection bias, and victims' misclassified in other groups of accidents.

In conclusion, injuries to the head are the most prevalent injuries among motorcyclists in RTIs. So it is suggested that proper interventions be implemented to ensure wearing helmet by motorcyclist and pillion passengers.

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